

NATURAL RESOURCES

Reversing Human Impacts on Fish Evolution

Next time you catch a “big one,” throw it back. This practice might seem counterintuitive, given that minimum size regulations favor keeping the larger fish, but it could reap long-range dividends for fish and humans alike, according to a study published online 4 March 2009 ahead of print in the *Proceedings of the Royal Society B*. Since 1990, scientists have observed that fish are getting smaller and growing more slowly as humans have continued to harvest the largest fish in wild stocks. Selecting out the large fish from a population sets the stage for earlier adult maturation, which means smaller fish are producing fewer eggs and offspring. This, in turn, could shrink many wild harvests. But the news is not all bad: The new study by David O. Conover, dean and director of the School of Marine and Atmospheric Sciences at Stony Brook University in New York, indicates fishery-induced genetic change can be slowly reversed.

Conover and his colleagues report on an empirical simulation experiment wherein captive populations of Atlantic silverside (*Menidia menidia*), a bait fish, were caught off the coast of the Great South Bay, New York. Groups of fish were selectively culled for the largest fish, mimicking the practice of most fisheries. The populations evolved smaller body size during the first five generations, and the smaller fish became less fertile because they produced fewer eggs.

“In our experiment,” says Conover, “the females were getting so small and producing eggs that were so small that the survival of those eggs and larvae were reduced dramatically. We would have eventually driven our own study population into extinction if we hadn’t stopped the large harvesting after five generations. We were struggling to produce enough fish for the sixth generation.”

From the sixth through tenth (and final) generation, fish were harvested at random. The fish populations showed a slow but significant increase in size, although they did not reach full recovery. The researchers estimate that it would take about 12 generations of random harvests for

the body size of this fish to return to normal. Harvested fish species typically have generation times of 3–7 years, so recovery of some overfished populations could take 3–8 decades, given a size decline of the magnitude induced in this study.

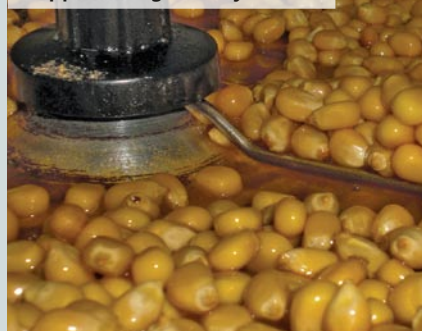
Chris Darimont, a postdoctoral fellow at the University of California, Santa Cruz, says, “Scientists have almost exclusively studied how exploited populations have undergone undesirable changes such as smaller sizes or less productive breeding schedules. But this study looks at what happens when a population is released from size-selective predation.” Darimont wrote that human predation is rapidly accelerating the rate of observable trait changes in commercially harvested species in the 20 January 2009 issue of the *Proceedings of the National Academy of Sciences*.

Fish provides more than 2.9 billion people with at least 15% of their average per-capita animal protein intake, according to the *World Fisheries and Aquaculture 2008* report by the Food and Agriculture Organization of the United Nations. The report says that 80% of all marine fish stocks for which assessment information is available are fully exploited or overexploited.

To help recover an overexploited population, fishery managers could establish “slot limits” that allow harvesting only of mid-size fish, according to Conover. Individual fish above a maximum size or below a minimum size would have to be returned. Slot limits apply evolutionary pressure on young fish to grow more quickly so they become larger and mature earlier. “The individual fish that survive the window would be allowed to grow large, and fecundity goes up exponentially with length,” says Conover. Maine’s lobster fishery has a slot limit.

Slot limits for some fisheries could have direct human health benefits, Conover says. In some fish such as tuna, the largest and oldest accumulate the highest levels of pollutants such as mercury. By not commercially harvesting the largest and most contaminated fish, people would be less likely to eat them. —John Tibbetts

Some popcorn makers have stopped using diacetyl.



degenerative and potentially fatal lung disease. Regulation of worker exposure to diacetyl had been delayed by a Bush-era Advance Notice of Proposed Rulemaking, but in March 2009, Secretary of Labor Hilda Solis announced the withdrawal of the notice, which could allow OSHA to move forward more quickly with new regulations. The flavoring is deemed “generally regarded as safe” by the FDA; one case of bronchiolitis obliterans was identified in a consumer who ate two bags of microwave popcorn each day for several years.

New Gases on the Radar

At March’s Greenhouse 2009 meeting in Perth, Australia, researchers presented new information on two gases that have been linked with global warming for over a decade. Atmospheric levels of nitrogen trifluoride (which replaced perfluorocarbons in circuit board manufacturing) and sulfur hexafluoride (which replaced methyl bromide in pest control) are still low, but they are increasing rapidly—which is not unexpected, given their relatively recent introduction to the atmosphere. Controlling nitrogen trifluoride could be particularly key because it persists for hundreds of years in the atmosphere. The team called for the two gases to be added to future versions of the Kyoto Protocol.

Climate Change Concerns Farmers

Across the globe, agricultural experts are calling on farmers to take climate change into account as they go about the business of feeding the world. In March 2009, the European Commission released a draft report warning that farmers in some regions of Europe may face disparities in crop production because of

uneven effects of global warming across the region. To reduce emissions and prepare for climatic changes, the report endorses renewable energy and biotechnology, and also advocates a variety of organic soil management practices that help store carbon and are more resilient to climate fluctuations. In southern India, a women’s collective is already planting novel crop combinations, using fewer chemicals, and embracing other sustainable practices.



Growing a variety of crops in tandem can increase soil health.